

WHAT IS CLAIMED IS:

1. A surface acoustic wave device comprising:

at least one surface acoustic wave filter having at least two interdigital transducers arranged along a surface acoustic wave propagation direction, the at least one surface acoustic wave filter being arranged on a piezoelectric substrate so as to have a balanced-to-unbalanced conversion function and two balanced signal terminals being connected to the surface acoustic wave filter; and

surface acoustic wave resonators including an interdigital transducer sandwiched between reflectors are correspondingly connected in series to said two balanced signal terminals; wherein

a center-to-center distance between mutually adjacent electrode fingers in the reflector and the interdigital transducers in one of the surface acoustic wave resonators differs from that of the other surface acoustic wave resonator.

2. A surface acoustic wave device according to Claim 1, wherein, when the wavelength determined by the structure of the interdigital transducer of said surface acoustic wave filter is denoted as λ , and when the center-to-center distances between mutually adjacent electrode fingers in the reflector and the interdigital transducer in said two surface acoustic wave resonators are correspondingly denoted as $X\lambda$ and $Y\lambda$, the following relationship is satisfied:

$$(0 + 0.5n)\lambda < |X - Y|\lambda \leq (0.18 + 0.5n)\lambda$$

where $n = 0, 1, 2, \dots$

3. A surface acoustic wave device according to Claim 1, wherein two longitudinally coupled resonator-type surface acoustic wave filters having three interdigital transducers are provided.

4. A surface acoustic wave device according to Claim 1, wherein two longitudinally coupled resonator-type surface acoustic wave filters having five interdigital transducers are provided.

5. A surface acoustic wave device according to Claim 1, wherein the at least one surface acoustic wave filter is a longitudinally coupled resonator-type surface acoustic wave filter having three interdigital transducers.

6. A surface acoustic wave device according to Claim 1, wherein the at least one surface acoustic wave filter is a longitudinally coupled resonator-type surface acoustic wave filter having five interdigital transducers.

7. A surface acoustic wave device according to Claim 6, wherein at least one of the interdigital transducers of said longitudinally coupled resonator-type surface acoustic wave filter is divided in a surface acoustic wave propagation direction.

8. A surface acoustic wave device according to Claim 6, wherein at least one of the interdigital transducers of said longitudinally coupled resonator-type surface acoustic wave filter is divided in a surface acoustic wave cross-width direction.

9. A surface acoustic wave device according to Claim 1, further comprising a package, wherein said piezoelectric substrate is face-down mounted in the package.

10. A communication device comprising the surface acoustic wave device according to Claim 1.

11. A surface acoustic wave device comprising:
at least one surface acoustic wave filter having at least two interdigital transducers arranged along a surface acoustic wave propagation direction, the at least one surface acoustic wave filter being arranged on a piezoelectric substrate so as to have a balanced-to-unbalanced conversion function and two balanced signal terminals being connected to the surface acoustic wave filter; and

surface acoustic wave resonators including an interdigital transducer sandwiched between reflectors are correspondingly connected in series to said two balanced signal terminals; wherein

a pitch ratio of a pitch of the reflectors to a pitch of the interdigital transducer in one of the surface acoustic wave resonators is different from a pitch ratio of a pitch of the reflectors to a pitch of the interdigital transducer in the other surface acoustic wave resonator.

12. A surface acoustic wave device according to Claim 11, wherein, when the ratio of the pitch of the reflectors to the pitch of the interdigital transducer in said two surface acoustic wave resonators are correspondingly denoted as a and b, the following relationship is satisfied:

$$0.984 \leq a/b < 1.$$

13. A surface acoustic wave device according to Claim 11, wherein two longitudinally coupled resonator-type surface acoustic wave filters having three interdigital transducers are provided.

14. A surface acoustic wave device according to Claim 11, wherein two longitudinally coupled resonator-type surface acoustic wave filters having five interdigital transducers are provided.

15. A surface acoustic wave device according to Claim 11, wherein the at least one surface acoustic wave filter is a longitudinally coupled resonator-type surface acoustic wave filter having three interdigital transducers.

16. A surface acoustic wave device according to Claim 11, wherein the at least one surface acoustic wave filter is a longitudinally coupled resonator-type surface acoustic wave filter having five interdigital transducers.

17. A surface acoustic wave device according to Claim 16, wherein at least one of the interdigital transducers of said longitudinally coupled resonator-type surface acoustic wave filter is divided in a surface acoustic wave propagation direction.

18. A surface acoustic wave device according to Claim 16, wherein at least one of the interdigital transducers of said longitudinally coupled resonator-type surface acoustic wave filter is divided in a surface acoustic wave cross-width direction.

19. A surface acoustic wave device according to Claim 11, further comprising a package, wherein said piezoelectric substrate is face-down mounted in the package.

20. A communication device comprising the surface acoustic wave device according to Claim 11.

21. A surface acoustic wave device comprising:
at least one surface acoustic wave filter having at least two interdigital transducers arranged along a surface acoustic wave propagation direction, the at least one surface acoustic wave filter being arranged on a piezoelectric substrate so as to have a balanced-to-unbalanced conversion function and two balanced signal terminals being connected to the surface acoustic wave filter; and

surface acoustic wave resonators including an interdigital transducer sandwiched between reflectors are correspondingly connected in series to said two balanced signal terminals; wherein

a duty in at least one of the interdigital transducer and the reflector in one of the surface acoustic wave resonators differs from that of the other surface acoustic wave resonator.

22. A surface acoustic wave device according to Claim 21, wherein, when the duties in the at least one of the interdigital transducer and the reflector in said two surface acoustic wave resonators are correspondingly denoted as x and y , the following relationship is satisfied:

$$0 < |x - y| \leq 0.05.$$

23. A surface acoustic wave device according to Claim 21, wherein two longitudinally coupled resonator-type surface acoustic wave filters having three interdigital transducers are provided.

24. A surface acoustic wave device according to Claim 21, wherein two longitudinally coupled resonator-type surface acoustic wave filters having five interdigital transducers are provided.

25. A surface acoustic wave device according to Claim 21, wherein the at least one surface acoustic wave filter is a longitudinally coupled resonator-type surface acoustic wave filter having three interdigital transducers.

26. A surface acoustic wave device according to Claim 21, wherein the at least one surface acoustic wave filter is a longitudinally coupled resonator-type surface acoustic wave filter having five interdigital transducers.

27. A surface acoustic wave device according to Claim 26, wherein at least one of the interdigital transducers of said longitudinally coupled resonator-type surface acoustic wave filter is divided in a surface acoustic wave propagation direction.

28. A surface acoustic wave device according to Claim 26, wherein at least one of the interdigital transducers of said longitudinally coupled resonator-type surface acoustic wave filter is divided in a surface acoustic wave cross-width direction.

29. A surface acoustic wave device according to Claim 21, further comprising a package, wherein said piezoelectric substrate is face-down mounted in the package.

30. A communication device comprising the surface acoustic wave device according to Claim 21.

31. A surface acoustic wave device comprising:

at least one surface acoustic wave filter having at least two interdigital transducers arranged along a surface acoustic wave propagation direction, the at least one surface acoustic wave filter being arranged on a piezoelectric substrate so as to have a balanced-to-unbalanced conversion function and two balanced signal terminals being connected to the surface acoustic wave filter; and

surface acoustic wave resonators including an interdigital transducer sandwiched between reflectors are correspondingly connected in series to said two balanced signal terminals; wherein

at least two of a center-to-center distance between mutually adjacent electrode fingers in the reflector and the interdigital transducer, a pitch ratio in the reflector and the interdigital transducer, and a duty in at least one of the interdigital transducer and the reflector in one of the surface acoustic wave resonators differ from those of the other surface acoustic wave resonator.

32. A surface acoustic wave device according to Claim 31, wherein two longitudinally coupled resonator-type surface acoustic wave filters having three interdigital transducers are provided.

33. A surface acoustic wave device according to Claim 31, wherein two longitudinally coupled resonator-type surface acoustic wave filters having five interdigital transducers are provided.

34. A surface acoustic wave device according to Claim 31, wherein the at least one surface acoustic wave filter is a longitudinally coupled resonator-type surface acoustic wave filter having three interdigital transducers.

35. A surface acoustic wave device according to Claim 31, wherein the at least one surface acoustic wave filter is a longitudinally coupled resonator-type surface acoustic wave filter having five interdigital transducers.

36. A surface acoustic wave device according to Claim 35, wherein at least one of the interdigital transducers of said longitudinally coupled resonator-type surface acoustic wave filter is divided in a surface acoustic wave propagation direction.

37. A surface acoustic wave device according to Claim 35, wherein at least one of the interdigital transducers of said longitudinally coupled resonator-type surface acoustic wave filter is divided in a surface acoustic wave cross-width direction.

38. A surface acoustic wave device according to Claim 31, further comprising a package, wherein said piezoelectric substrate is face-down mounted in the package.

39. A communication device comprising the surface acoustic wave device according to Claim 31.